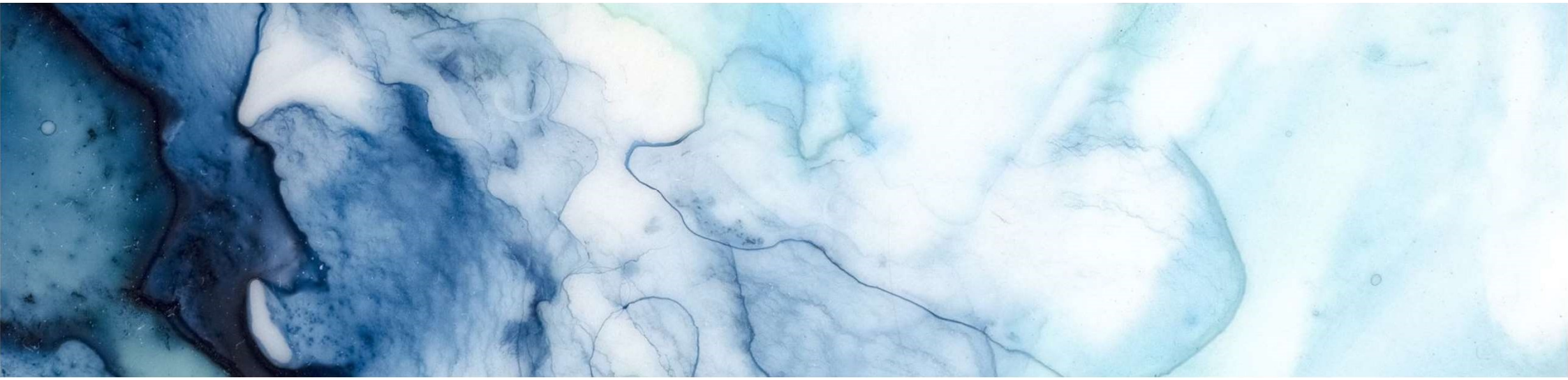

FLOOD MAPPING AND DAMAGE ASSESSMENT USING SENTINEL-1 SAR DATA

Janis Kapenieks

23rd of October, 2024, Paris

Funded by the European Union

RIGA TECHNICAL UNIVERSITY

TED4LAT

Background of my Research

- Global warming has led to an increase in the frequency of extreme weather events.
- In 2024, Latvia experienced the impact of cyclone Kirsti, leading to wind and rain damage in Zemgale and Western Vidzeme.
- Lots of data generated for scientific research.

LSM.lv Latvian public media

Replay Latvian Television Latvian Radio

Tuesday, October 22 Name days: Iride, Iris, A

Riga +13 °C, D wind, 5m/s

IMPORTANT » Russia's invasion of Ukraine Rail Baltica State budget 2025 Riga International Film Festival Taxes the Is

The storm experienced at the end of July was the strongest summer storm in the history of Latvian observations

Share:

Strong rain and storm damage in Jurmala. LETA, Lita Miller

August 2, 10:46 | Latvia | LETA

On the night of July 29, Latvia was hit by the most intense rainfall and the strongest summer storm in the history of observations, according to the Latvian Environment, Geology and Meteorology Centre (LVGMC)

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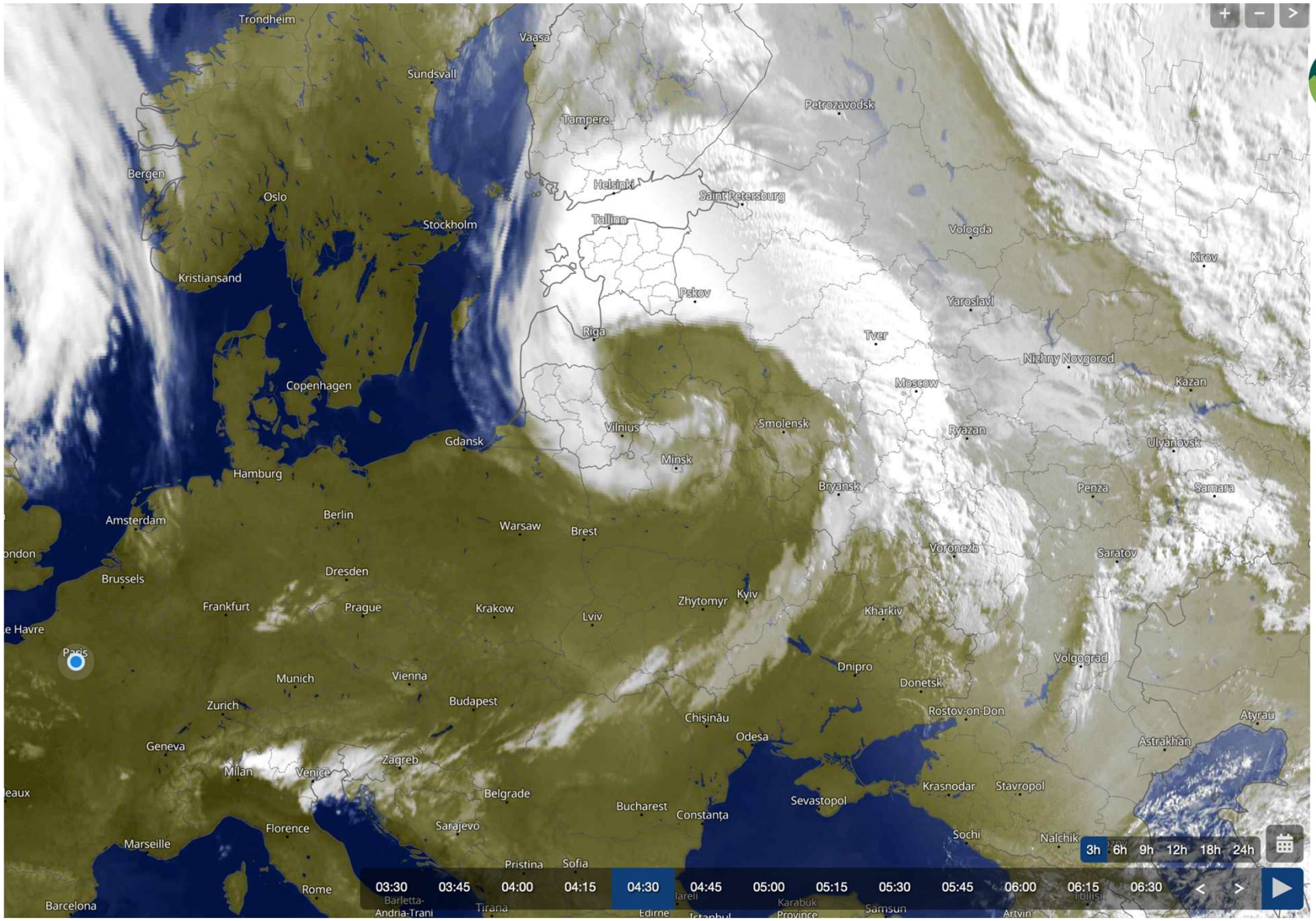


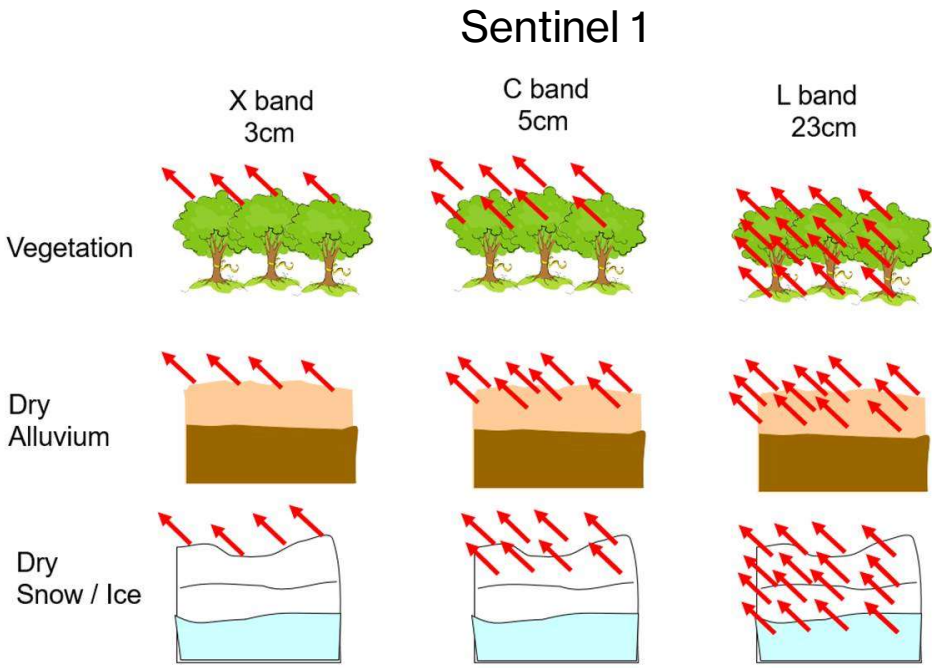
Source: https://www.meteoblue.com/en/weather/maps#map=satellite~sat~none~none~none&coords=4/54.25

Research Objectives

- The aim of my research is to identify the most effective algorithms for flood detection in **agricultural** and low-density urban areas.
- My goal is to create a reliable methodology for initial damage assessment just after or during the flooding event.
- The primary data source utilized in this study is satellite imagery from Sentinel-1 GRD. Sentinel-1 GRD offers C-band synthetic aperture radar imaging, allowing for the acquisition of images regardless of weather conditions.

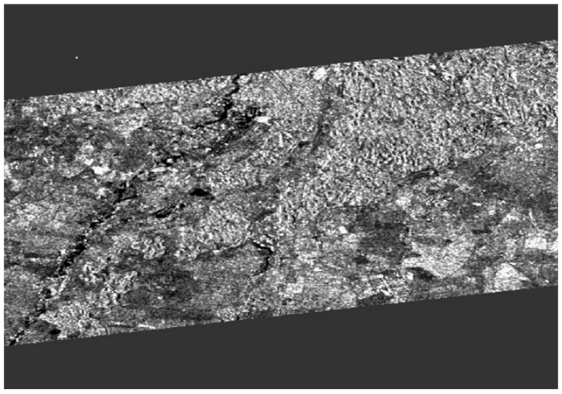
Research Methods/Data Sources

- The main data source: satellite imaging services. Several types of image data available, based on different sensor technology:
  - **Multispectral imagery**
  - **Hyperspectral imagery**
  - **SAR Data (Synthetic Aperture Radar) X/C/L-band**
    - **SAR technology uses radar waves to illuminate the Earth's surface and capture the backscattered signals.**
    - **The captured signal is processed to create radar images. SAR technology advantage is the system can penetrate clouds, see beneath trees, and work in all weather conditions.**

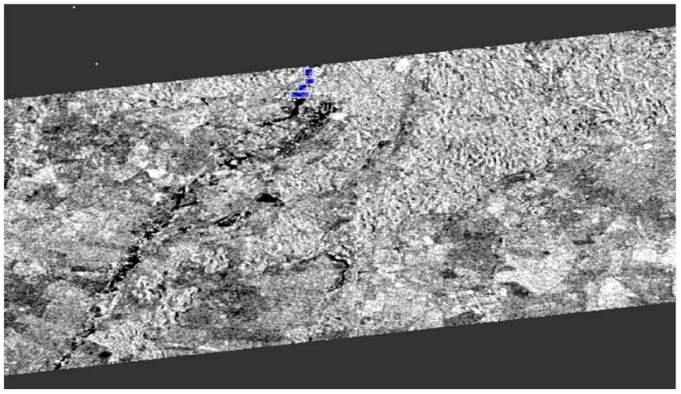


Research Methodology

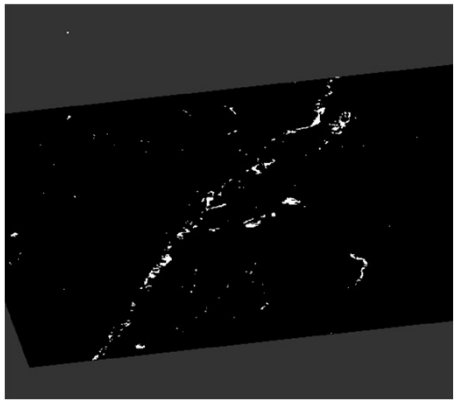
Typical workflow: three main steps of satellite image processing



Linear scale



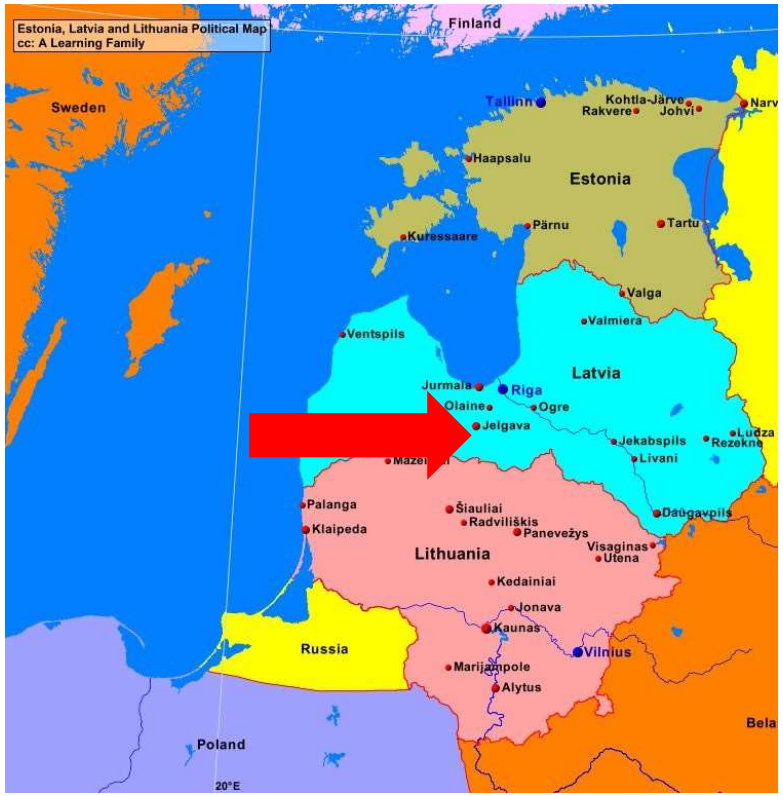
db scale



Water mask

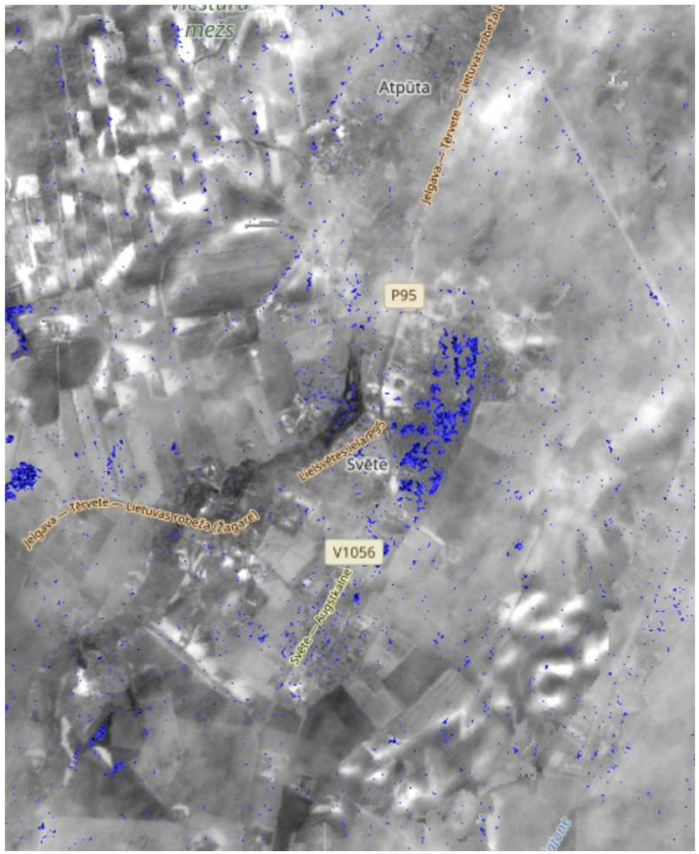
Created using SNAP (Sentinel Applications Platform)

Detetcting Floods

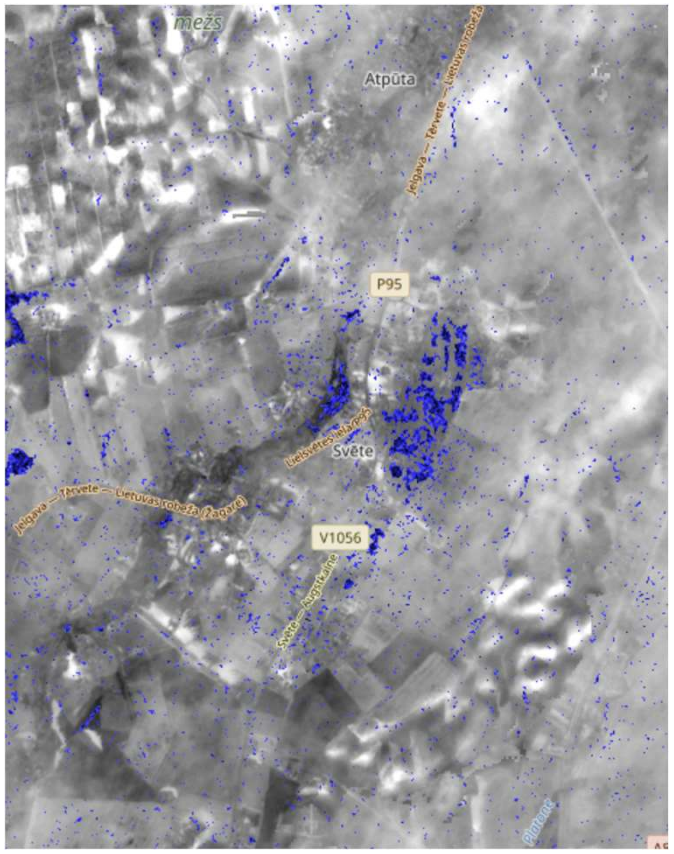


Source: https://www.lsm.lv/galerijas/38612/jelgavas-apkartne-parplust-svetes-upe

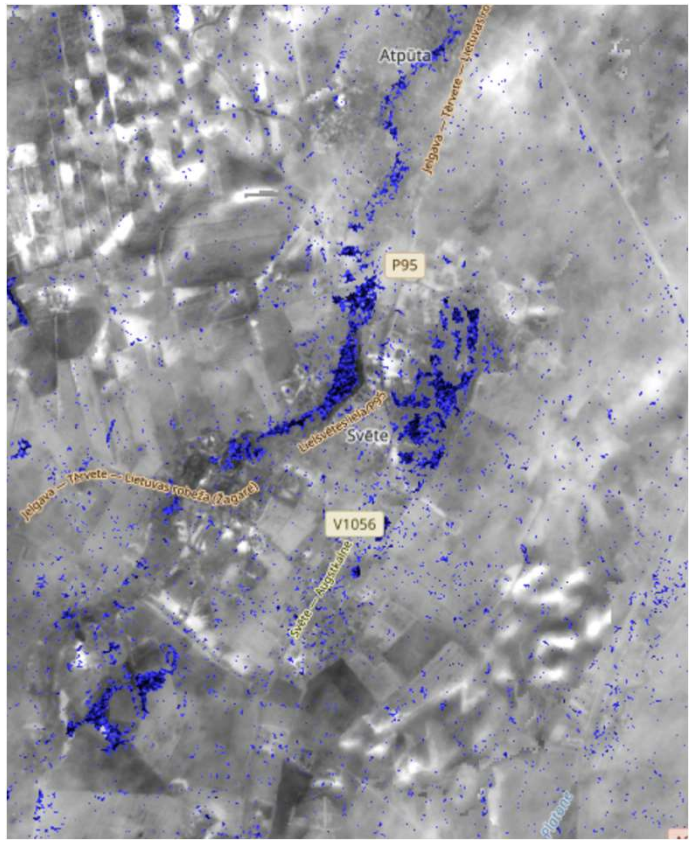
Detetcting Floods



29/07/2024



31/07/2024



05/08/2024

Crop fields: Three Types of Damage

Flattened crop

Water damage

And combined

Source: https://www.lsm.lv/raksts/zinas/ekonomika/29.07.2024-vetra-cies-ari-zemnieku-saimniecibas-zemgale.a563074/

Hypothesis

- H1: Water and wind damaged agricultural fields can be identified using remote sensing data from Sentinel-1 (C-Band radar).

- Water and wind damaged agricultural fields can be distingushed from “normal” fields.

Data: damaged fields

Source: https://karte.lad.gov.lv/

Field ID	Cereals type
46202-25718	Oats
50065-30216	Barley, summer
48579-26910	Wheat, winter
48538-26900	Wheat, winter
47539-28145	Wheat, winter
50521-25565	Wheat, winter
47301-27064	Wheat, winter
54319-33663	Oats
49323-28454	Wheat, summer
48961-28767	Rye
46575-28426	Barley, summer
51188-27599	Wheat, winter
511220-27604	Wheat, winter
51227-27638	Barley, summer
51104-27660	Wheat, winter

Source: Rural Support Service, Ministry of Agriculture

Current Challenges & Further Steps

Current challenges:

- Resolution challenges
- Physical limitations of C-band radar, vegetation reflects C-band microwaves
- Background noise identification and removal => reduces resolution

Further steps:

- Visual inspection approaches (thresholding)
- Clustering
- Classification algorithm/s (machine learning)

Related Works

- **Lahsaini, M.; Albano, F.; Albano, R.; Mazzariello, A.; Lacava, T. A Synthetic Aperture Radar-Based Robust Satellite Technique (RST) for Timely Mapping of Floods. *Remote Sens.* 2024, *16*, 2193. https://doi.org/10.3390/rs16122193**
- **Lang, F.; Zhu, Y.; Zhao, J.; Hu, X.; Shi, H.; Zheng, N.; Zha, J. Flood Mapping of Synthetic Aperture Radar (SAR) Imagery Based on Semi-Automatic Thresholding and Change Detection. *Remote Sens.* 2024, *16*, 2763. https://doi.org/10.3390/rs16152763**
- **Manglem, Abujam. (2022). Flood Mapping in Valley Districts of Manipur Using Satellite-based Synthetic Aperture Radar (SAR) Images. Ecology, Environment and Conservation. 28. S480-S487. 10.53550/EEC.2022.v28i07s.079 Manglem, Abujam. (2022). Flood Mapping in Valley Districts of Manipur Using Satellite-based Synthetic Aperture Radar (SAR) Images. Ecology, Environment and Conservation. 28. S480-S487. 10.53550/EEC.2022.v28i07s.079**

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Q & A

Merci